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(54) Ultrasonic dissector

Ultraschalldissektor

Dissecteur ultrasonique

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(73) Proprietor: **United States Surgical Corporation**
Norwalk, Connecticut 06856 (US)

(72) Inventor: **White, Jeffrey S.**
Ridgefield, CT 06877 (US)

(74) Representative: **Marsh, Roy David et al**
Hoffmann Eitle,
Patent- und Rechtsanwälte,
Arabellastrasse 4
81925 München (DE)

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EP 0 830 845 B1

Description

BACKGROUND

1. Technical Field

[0001] The present disclosure relates to an ultrasonic instrument for surgical use. More specifically, the present disclosure relates to an ultrasonic instrument having an angled blade member and a clamp member particularly suited for use in performing dissection and coagulation of tissue. The features of the pre-characterizing part of claim 1 below are disclosed in EP-A-456 470.

2. Background of Related Art

[0002] Ultrasonic instruments for surgical use and the benefits associated therewith are well known. For example, the use of an ultrasonic generator in conjunction with a surgical scalpel facilitates faster and easier cutting of organic tissue and accelerates blood vessel clotting in the area of the cut, i.e., accelerated coagulation. Improved cutting results from increased body tissue to scalpel contact caused by the high frequency of vibration of the scalpel blade with respect to body tissue. Improved coagulation results from heat generated by contact between the scalpel blade and the body tissue as the scalpel blade is vibrated at a high frequency. Thus, in order to reap the advantages associated with ultrasonic energy, good blade to tissue contact is important.

[0003] U.S. Patent No. 3,862,630 ("Balamuth") discloses an ultrasonic system including an ultrasonic motor, a tool member having a working surface oriented normal to the direction of mechanical vibration generated by the ultrasonic motor, and a clamp member extending parallel to the tool member for compressing tissue against the tool member. U.S. Patent No. 5,322,055 ("Davison") discloses an ultrasonic surgical instrument adapted for endoscopic use having a blade and a clamp movable in relation to the blade to capture tissue therebetween. The blade and the clamp define a clamping region having a plane which is parallel to the longitudinal axis of the surgical instrument. During an endoscopic procedure, movement of the instrument is limited to movement along an axis parallel to the plane of the clamping region. Thus, no additional blade force is imposed on the body tissue as a result of movement of the instrument.

[0004] Accordingly, a need exists for an improved ultrasonic surgical instrument which is easy to use and provides fast and easy cutting and improved coagulation.

SUMMARY

[0005] In accordance with the present disclosure, an ultrasonic surgical instrument as defined in claim 1 below is useful for dissection and coagulation of tissue. The surgical instrument includes a housing and a vibration coupler supported within the housing operably connected to an ultrasonic generator. An angled blade member is connected to the distal end of the vibration coupler to conduct high frequency vibration to the blade member. A clamp member that may be positioned adjacent to the blade member is movable from a first position to a second approximated position to capture tissue therebetween. The clamp member and angled blade member combine to enhance contact between the tissue and the blade member during operation of the instrument to improve the performance of the instrument.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Various preferred embodiments are described herein with reference to the drawings, wherein:

FIG. 1 is a perspective view of one embodiment of the ultrasonic instrument;

FIG. 2 is a side partial cross-sectional view of the ultrasonic instrument shown in FIG. 1;

FIG. 2A is a side partial cross-sectional view of the proximal end of the ultrasonic instrument shown in FIG. 1 with the actuation rod biased to its distalmost position;

FIG. 2B is a side partial cross-sectional view of the proximal end of the ultrasonic instrument shown in FIG. 1 further including a biasing and retaining mechanism wherein the actuation rod is retained in a retracted position;

FIG. 2C is a side partial cross-sectional view of the clamp member and blade member of the ultrasonic instrument shown in FIG. 1 in the open position;

FIG. 2D is a side partial cross-sectional view of the clamp member and the blade member of the ultrasonic instrument shown in FIG. 1 in the closed position;

FIG. 3 is a cross-sectional view taken along section line 3-3 of FIG. 2;

FIG. 4 is a cross-sectional view taken along section line 4-4 of FIG. 2C;

FIG. 4A is a cross-sectional view taken along section line 4A-4A of FIG. 2D;

FIG. 5 is a side partial cross-sectional view of an alternate embodiment of the ultrasonic instrument;

FIG. 6 is a side partial cross-sectional view of the blade member and clamp member shown in FIG. 5 with the clamp member in the open position; and

FIG. 6A is a partial side cross-sectional view of the blade member and the clamp member shown in FIG. 5 in the closed position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0007] Preferred embodiments of the presently dis-

closed ultrasonic dissector will now be described in detail with reference to the drawings, in which like reference numerals designate identical or corresponding elements in each of the several views.

[0008] FIGS. 1-3 illustrate one embodiment of the presently disclosed ultrasonic instrument shown generally as 10. Briefly, ultrasonic instrument 10 includes a substantially cylindrical outer housing 12, preferably formed from molded housing half-sections, having an open distal end 14 and a closed proximal end 16. The housing 12 may be formed with a gripping member 17. The proximal end 16 of housing 12 is formed with a slot 18 dimensioned to slidably receive an actuation rod 20 which will be discussed in further detail below. A remotely located ultrasonic generator 22 is electrically connected to a transducer 23 via conventional means, such as a power cable 34. The transducer 23 is supported within the housing and engages a vibrator coupler 24 which extends longitudinally towards the distal end 14 of housing 12. A blade member 26 having a cutting edge 32 is provided at the distal end of the vibration coupler 24. The blade member 26 is fixedly connected to the vibration coupler 24 or alternately integral therewith, such that the cutting edge 32 defines a plane oriented at an acute fixed angle, preferably from about 30 degrees to about 70 degrees, with respect to the longitudinal axis of the instrument.

[0009] Ultrasonic generator 22 provides electrical energy having ultrasonic frequency to the transducer 23 to cause oscillation of the transducer 23 in a known manner. The transducer 23, which may be one of a variety of electromechanical types, e.g., electrodynamic, piezoelectric, magnetostrictive, is connected in end-to-end relation to the vibration coupler 24 to cause oscillation of the vibration coupler and corresponding oscillation of angled blade member 26.

[0010] Actuation rod 20 is movably supported within housing 12 and extends from the proximal end of housing 12, via slot 18, through the open distal end 14 of housing 12. Preferably, rod 20 is supported by brackets 36 which may be integrally formed with housing 12, although any conventional support structure which allows for linear movement of the actuation rod may be used. A proximal engagement surface 38 located externally of the housing 12 facilitates selective advancement of the actuation rod 20. Clamp 28 is connected to the distal end of the actuation rod 20 and includes clamp surface 30 which is substantially parallel to and faces cutting edge 32 of blade member 26. The clamp 28 is movable with respect to the blade member 26 from an open position to a closed position to capture tissue between the cutting edge 32 and the clamp surface 30. The clamp 28 may alternately be formed integral with the actuation rod 20 and may have a smooth texture although a knurled or ribbed surface may be provided to facilitate grasping of tissue or to enhance coagulation.

[0011] Referring to FIGS. 2A-2B, a biasing mechanism may be provided to bias the actuation rod 20 to a distal position and thus bias clamp 28 to the closed position. The biasing mechanism includes an annular ring 31 secured to or formed integrally with the actuation rod 20 and a biasing spring 33. Biasing spring 33 is positioned about the actuation rod 20 between bracket 36 formed on housing 12 and annular ring 31 to continuously urge the actuation rod 20 distally. (See FIG. 2A.) A retaining member 35 is pivotally secured within a slot 37 formed in the housing and is pivotable into engagement with a rack 39 formed on the actuation rod 20. The retaining member 35 can be pivoted in the counterclockwise direction by moving slide member 41 proximally, as viewed in FIG. 2B, to selectively retain the clamp 28 at various locations between the open and closed positions. The slide member 41 may be moved distally to disengage retaining member 35 from rack 37, as illustrated in FIG. 2A, to clamp tissue 50 between the clamp surface 30 and the cutting edge 32.

[0012] In use, the ultrasonic instrument 10 is grasped about the proximal end of housing 12 and moved to position the cutting edge 32 adjacent tissue to be dissected and/or coagulated. The actuation rod 20 is retracted against the bias of spring 33 by pulling the engagement surface 38 of actuation rod 20 to retract clamp 28 away from blade 26 and provide access for tissue. In the open position, the clamp 28 is spaced from the blade member 26 a distance to permit easy tissue access. (See FIG. 2C and 4.) When tissue 50 is positioned between clamp 28 and blade 26, engagement surface 38 is released to allow biasing spring 33 to move clamp 28 to the closed position and to capture tissue 50 therebetween. (See FIGS. 2D and 4A.) The actuation rod 20 may be retained in the retracted position while the instrument 10 is positioned about tissue by pivoting retaining member 35 counter-clockwise into engagement with rack 39 formed on actuation rod 20. (See FIG. 2B.) Clearly, other means to retain actuation rod 20 can be utilized. The ultrasonic generator 22 is energized to cause linear oscillation of the blade 26 with respect to the clamp 28 to effect dissection and/or coagulation of tissue 50. Alternately, the actuation rod 20 may be biased proximally to the open position so the clamp is biased to the open position. In this alternate embodiment, a retaining means can be utilized to retain the clamp in the closed position.

[0013] FIGS. 5-6A illustrate a further embodiment of the presently disclosed ultrasonic dissector shown generally as 100. Ultrasonic dissector 100 is provided with a pivotable clamp 128. Briefly, ultrasonic dissector 100 includes a transducer 123 supported within a housing 112 and adapted to be connected to an ultrasonic generator 122 via power cable 134. The transducer 123 engages a vibration coupler 124 having a blade member 126 rigidly attached, or alternatively integral, to the distal end of the coupler 124 therewith.

[0014] A clamp 128 is pivotably mounted to the distal end of housing 112 about pivot member 119 such that clamp 128 extends through an open distal end 114 of housing 112. Actuation rod 120 is supported on brackets

136 for linear movement within housing 112. The distal end 121 of actuation rod 120 is connected to a proximal end of clamp 128 via pin 117 to translate linear advancement of the actuation rod 120 to clockwise rotation of clamp 128.

[0015] A thumb actuation member 138 is fixedly connected to actuation rod 120 by a link 143. The link 143 extends through slot 145 formed in housing 112 to facilitate linear advancement of the thumb actuation member 138 and corresponding linear advancement of the actuation rod 120. A biasing mechanism for biasing the actuation rod to a proximal position and a retaining mechanism to retain the actuation rod 120 in a distal position is shown in FIG. 5. Alternately, as discussed with respect to FIG. 2, the actuation rod 120 may be biased distally to maintain clamp member 128 in the closed position. In this alternate embodiment, a retaining member can be utilized to retain the clamp in the open position.

[0016] More specifically referring to FIGS. 5-6B, clamp member 128 of ultrasonic instrument 100 is biased to the open position by biasing spring 133, which engages annular ring 131 to urge actuation rod 120 proximally. After the instrument 100 is properly positioned about tissue, actuation rod 120 may be advanced distally against the bias of spring 133, via actuation member 138, to pivot the clamp member 128 into substantial alignment with blade member 126 and capture tissue between clamp surface 130 and cutting edge 132. (See FIG. 6A.) The retaining member 135 may be pivoted clockwise to retain the clamp member 128 and blade member 126 in the closed position. Clearly, other means to retain the clamp member 128 in the closed position can be utilized. After tissue is captured between the clamp member and the blade member, the ultrasonic generator 122 may be actuated to effect dissection and/or coagulation of body tissue. As illustrated in FIG. 6A, the instrument may be moved proximally, during operation of the instrument, as indicated by arrow "B", to increase the force applied by the cutting edge 132 on body tissue 150.

[0017] It will be understood that various modifications may be made to the embodiments disclosed herein. For example, different handle assemblies may be provided on the proximal end of the instrument to improve gripping of the instrument, e.g., pistol grip. Also, the clamp member may be biased to the open or closed position. The claims which follow identify embodiments of the invention additional to those described in detail above.

Claims

1. A surgical cutting instrument comprising:

   (a) a vibration coupler (24) connectable to an ultrasonic generator and defining a longitudinal axis;

   (b) a blade member (26) positioned adjacent a distal end portion of the vibration coupler and adapted to vibrate with the vibration coupler, the blade member having a cutting edge (32) that defines a plane oriented at an acute angle to the longitudinal axis during vibration of the vibration coupler;

   and **characterized by**:

   a clamp (28) positioned adjacent the blade member, the clamp having a tissue-engaging surface movable between a first, open position spaced from the of the cutting edge blade member and a second, clamped position wherein the tissue-engaging surface is moved towards the cutting edge

2. A surgical instrument according to claim 1, further including an actuation rod (20) operably connected to the clamp, the actuation rod being movable to move the clamp between the first and second positions.

3. A surgical instrument according to claim 1 or 2, wherein the clamp is moved linearly from the open to the clamped position.

4. A surgical instrument according to any of the preceding claims, wherein the clamp is pivoted from the open position to the clamped position.

5. A surgical instrument according to any of the preceding-claims, further comprising a biasing mechanism (31, 33) for biasing the clamp member with respect to the blade member.

6. A surgical instrument according to any of the preceding claims, further including a retaining mechanism (35, 39) to selectively retain the clamp at multiple locations between the first and clamped positions.

7. A surgical instrument according to any of the preceding claims, wherein the retaining mechanism includes a rack (39) positioned on the actuation rod and wherein the retaining mechanism further includes a retaining member (35) movable into operable engagement with the rack to retain the clamp in multiple locations between the open and clamped positions.

8. A surgical instrument according to any of the preceding claims, further including a housing (112), wherein the clamp is pivotably secured to the housing.

9. A surgical instrument according to any of the pre-

ceding claims, wherein the angle of the plane defined by the cutting surface of the blade member is from about 30 degrees to about 70 degrees.

10. A surgical instrument as claimed in any one of the preceding claims, wherein the cutting edge (32) is straight.

11. A surgical instrument as claimed in any one of the preceding claims, wherein the cutting edge (32) is continuous.

Patentansprüche

1. Ein chirurgisches Schneidinstrument, das aufweist:

   (a) einen Vibrationskoppler (24), der mit einem Ultraschallgenerator verbindbar ist und eine Längsachse bestimmt;

   (b) ein Klingenelement (26), das benachbart einem distalen Endabschnitt des Vibrationskopplers positioniert ist und mit dem Vibrationskoppler vibrierbar ist, wobei das Klingenelement eine Schneidkante (32) aufweist, die eine Ebene bestimmt, welche unter einem spitzen Winkel zur Längsachse bei der Vibration des Vibrationskopplers angeordnet ist,

   gekennzeichnet durch
   eine Klemme (28), die benachbart dem Klingenelement positioniert ist, wobei die Klemme, die eine Gewebeeingriffsoberfläche aufweist, zwischen einer ersten geöffneten Position, beabstandet von der Schneidkante des Klingenelements, und einer zweiten Klemm-Position, in der die Gewebeeingriffsoberfläche zur Schneidkante hin bewegt ist, bewegbar ist.

2. Ein chirurgisches Instrument nach Anspruch 1, des Weiteren mit einem Betätigungsstab (20), der betriebsmäßig mit der Klemme verbunden ist, wobei der Betätigungsstab bewegbar ist, um die Klemme zwischen der ersten und der zweiten Position zu bewegen.

3. Ein chirurgisches Instrument nach Anspruch 1 oder 2, wobei die Klemme von der geöffneten Position zur Klemm-Position linear bewegt wird.

4. Ein chirurgisches Instrument nach einem der vorhergehenden Ansprüche, wobei die Klemme von der geöffneten Position zur Klemm-Position gedreht wird.

5. Ein chirurgisches Instrument nach einem der vorhergehenden Ansprüche, des Weiteren mit einem Vorspannmechanismus (31, 33) zum Vorspannen des Klemmelements in Bezug auf das Klingenelement.

6. Ein chirurgisches Instrument nach einem der vorhergehenden Ansprüche, des Weiteren mit einem Haltemechanismus (35, 39) zum gezielten Halten der Klemme in verschiedenen Stellungen zwischen der ersten Position und der Klemm-Position.

7. Ein chirurgisches Instrument nach einem der vorhergehenden Ansprüche, wobei der Haltemechanismus eine Zahnstange (39) umfasst, die auf der Betätigungsstange positioniert ist, und wobei der Haltemechanismus des Weiteren ein Halteelement (35) umfasst, das in betriebsmäßigen Eingriff mit der Zahnstange bewegbar ist, um die Klemme in verschiedenen Stellungen zwischen der geöffneten Position und der Klemm-Position zu halten.

8. Ein chirurgisches Instrument nach einem der vorhergehenden Ansprüche, des Weiteren mit einem Gehäuse (112), wobei die Klemme drehbar an dem Gehäuse angebracht ist.

9. Ein chirurgisches Instrument nach einem der vorhergehenden Ansprüche, wobei der Winkel der Ebene, die von der Schneidoberfläche des Klingenelements bestimmt ist, im Bereich von ungefähr 30 Grad bis ungefähr 70 Grad liegt.

10. Ein chirurgisches Instrument nach einem der vorhergehenden Ansprüche, wobei die Schneidkante (32) gerade ausgebildet ist.

11. Ein chirurgisches Instrument nach einem der vorhergehenden Ansprüche, wobei die Schneidkante (32) durchgehend ausgebildet ist.

Revendications

1. Instrument de coupe chirurgical comprenant :

   (a) un coupleur de vibration (24) pouvant être connecté à un générateur ultrasonique et définissant un axe longitudinal ;
   (b) un élément formant lame (26) positionné d'une manière adjacente à la portion d'extrémité distale du coupleur de vibration et apte à vibrer avec le coupleur de vibration, l'élément formant lame présentant un bord coupant (32) qui définit un plan orienté selon un angle aigu à l'axe longitudinal pendant la vibration du coupleur de vibration ;

   et **caractérisé par** :

un organe de serrage (28) positionné d'une manière adjacente à l'élément formant lame, l'organe de serrage présentant une surface de mise en prise avec le tissu déplaçable entre une première position ouverte espacée du bord coupant de l'élément formant lame et une seconde position serrée où la surface de mise en prise avec le tissu est déplacée vers le bord coupant.

2. Instrument chirurgical selon la revendication 1, comportant en outre une tige d'actionnement (20) fonctionnellement reliée à l'organe de serrage, la tige d'actionnement étant déplaçable, pour déplacer l'organe de serrage entre les première et seconde positions.

3. Instrument chirurgical selon la revendication 1 ou 2, où l'organe de serrage est déplacé linéairement de la position ouverte à la position serrée.

4. Instrument chirurgical selon l'une des revendications précédentes, où l'organe de serrage est amené à pivoter de la position ouverte à la position serrée.

5. Instrument chirurgical selon l'une des revendications précédentes, comprenant en outre un mécanisme de sollicitation (31, 33) pour solliciter l'organe de serrage par rapport à l'élément formant lame.

6. Instrument chirurgical selon l'une des revendications précédentes, comportant en outre un mécanisme de retenue (35, 39) pour retenir sélectivement l'organe de serrage à des emplacements multiples entre la première position et la position serrée.

7. Instrument chirurgical selon l'une des revendications précédentes, où le mécanisme de retenue comporte une crémaillère (39) positionnée sur la tige d'actionnement, et où le mécanisme de retenue comporte en outre un élément de retenue (35) pouvant être amené en une prise fonctionnelle avec la crémaillère afin de retenir l'organe de serrage dans des emplacements multiples entre les positions ouverte et serrée.

8. Instrument chirurgical selon l'une des revendications précédentes, comportant en outre un boîtier (112), où l'organe de serrage est fixé d'une manière pivotante au boîtier.

9. Instrument chirurgical selon l'une des revendications précédentes, où l'angle du plan défini par la surface de coupe de l'élément formant lame s'étend depuis environ 30 degrés à environ 70 degrés.

10. Instrument chirurgical selon l'une des revendications précédentes, où le bord coupant (32) est rectiligne.

11. Instrument chirurgical selon l'une des revendications précédentes, où le bord coupant (32) est continu.

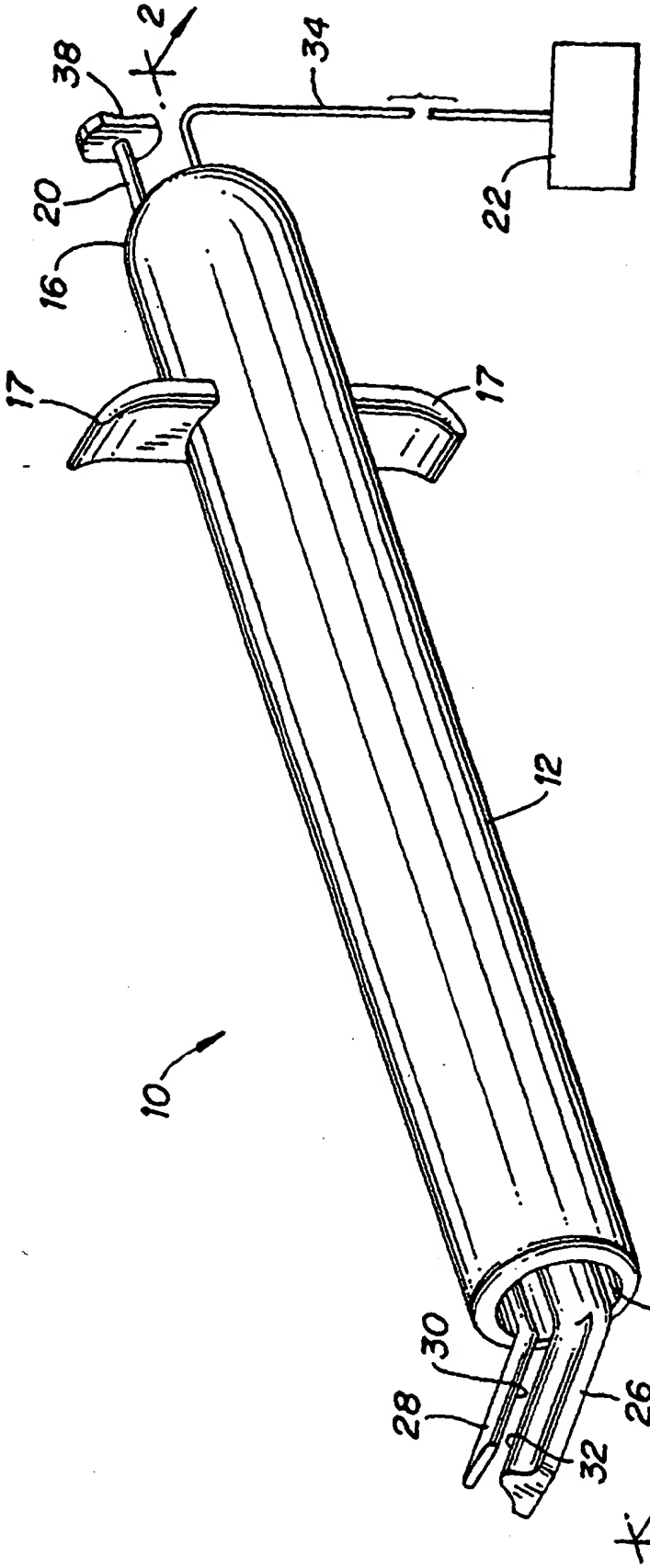


FIG_1

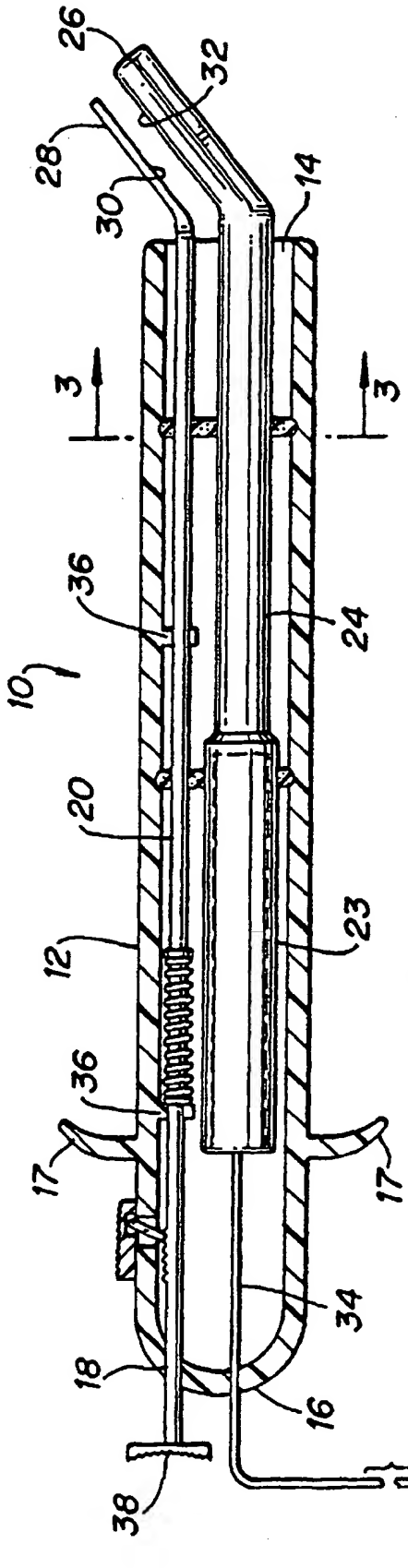


FIG. 2

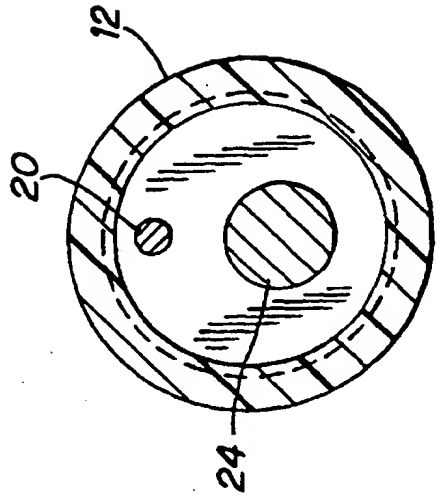


FIG. 3

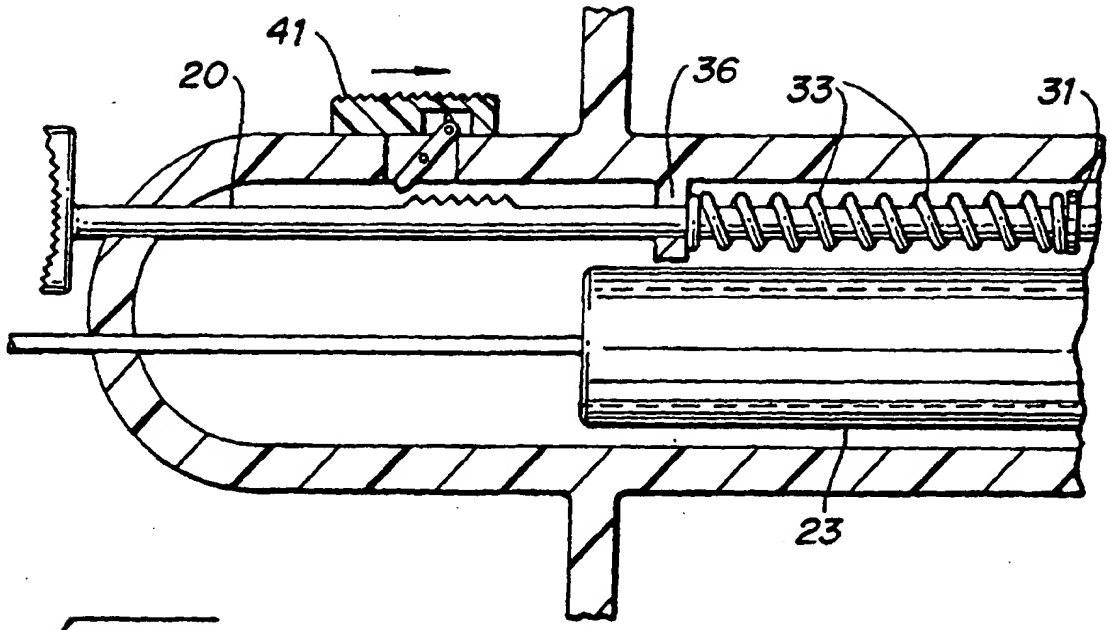


FIG. 2A

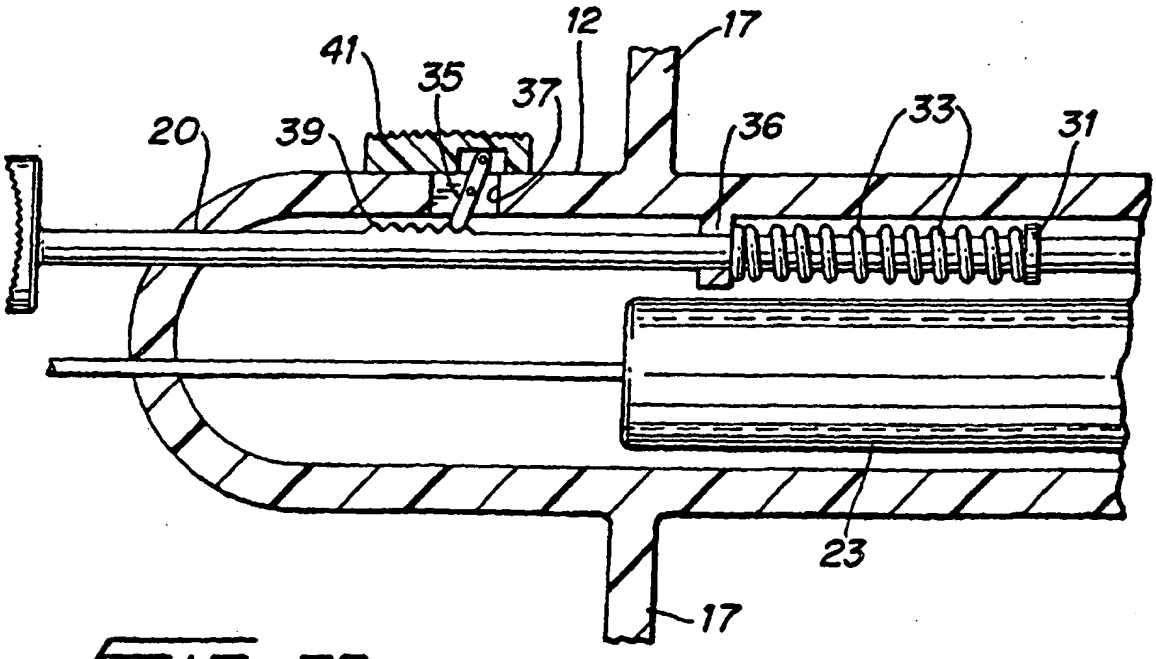


FIG. 2B

FIG. 2C

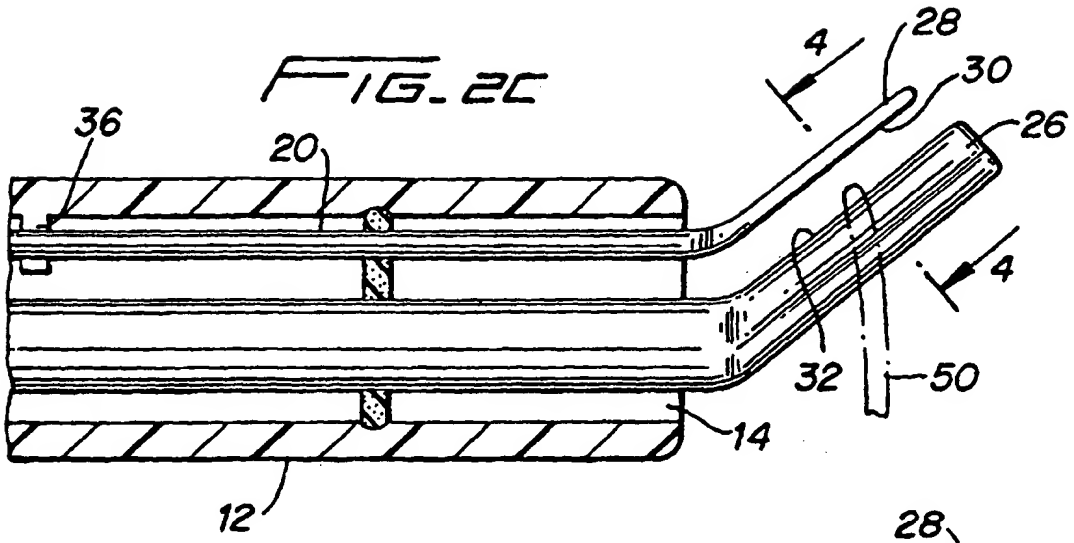


FIG. 4

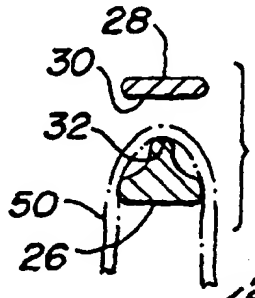


FIG. 2D

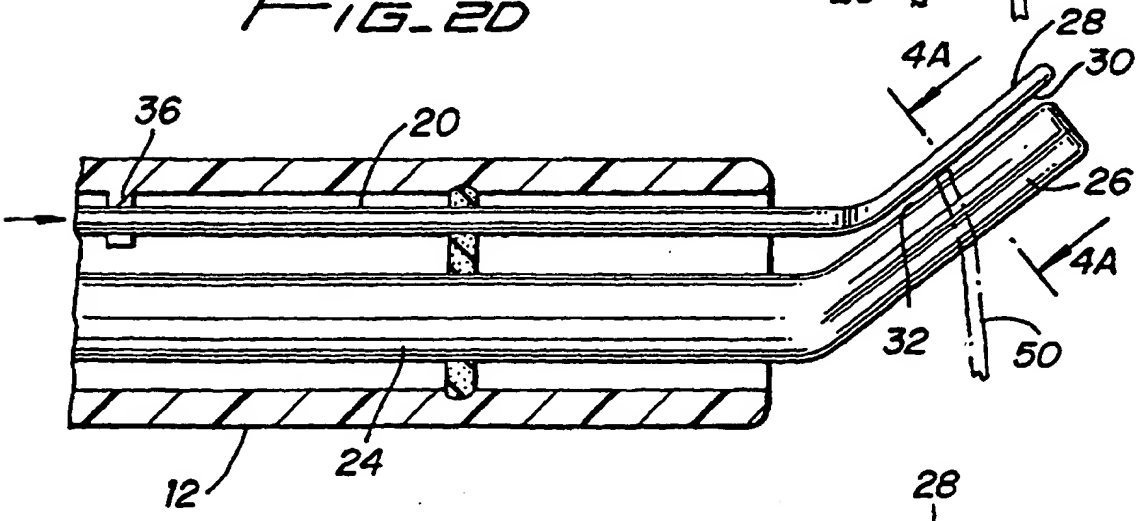
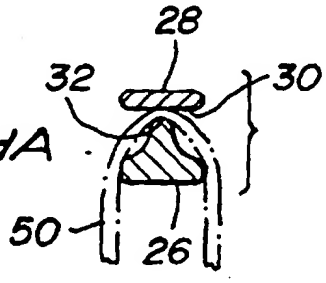
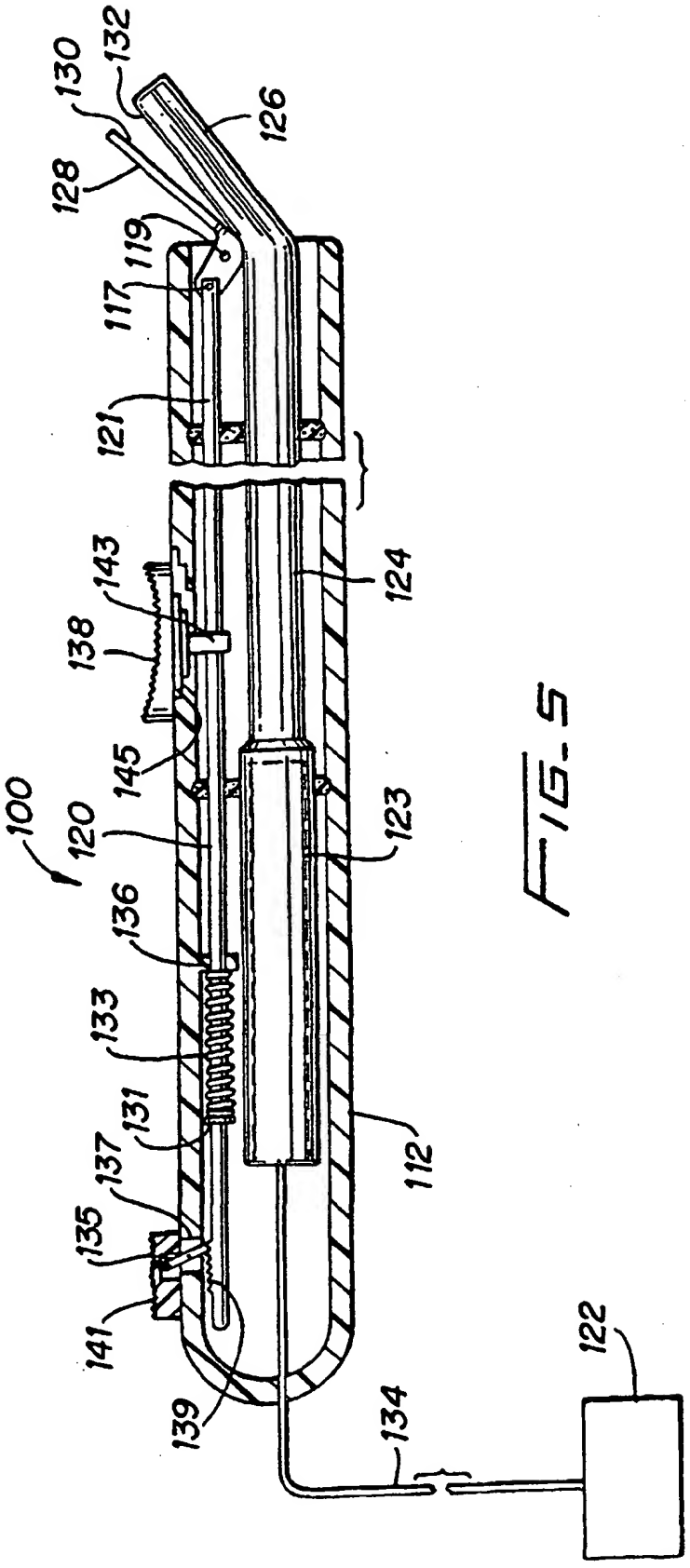


FIG. 4A

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128
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134
122

FIG. 5

FIG. 6

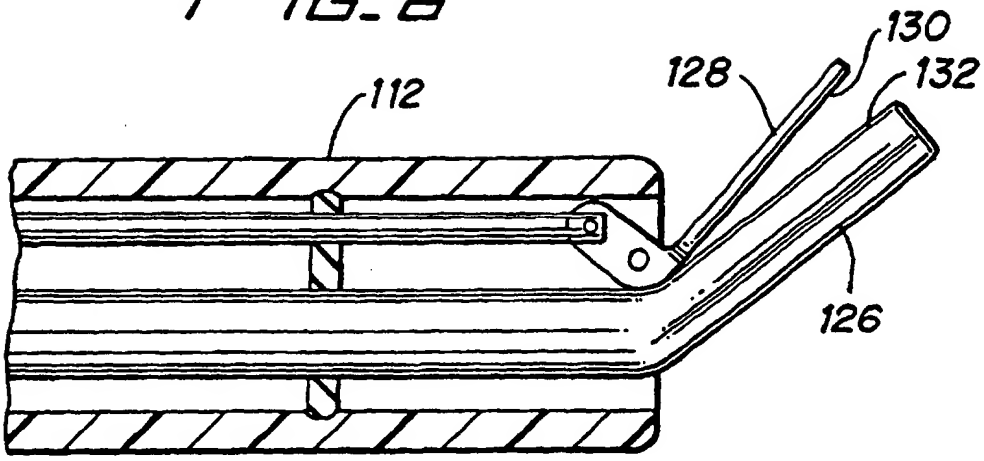

FIG. 6A